

Lunar Oxygen and Silicon Beneficiation Using Only Solar Power, Phase I

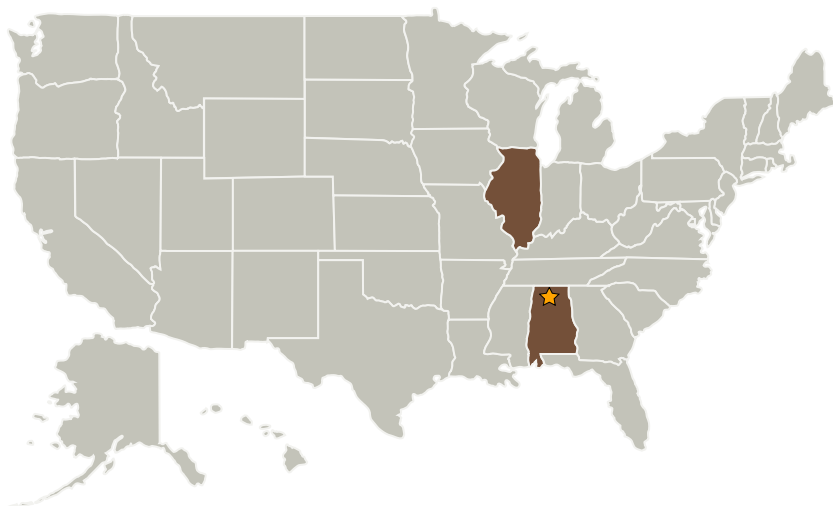
Completed Technology Project (2007 - 2007)



Project Introduction

Element beneficiation from a moving, ionized plasma can be accomplished through the principles of mass spectroscopy. Two US patents were recently awarded to the PI on a means to separate all isotopes of regolith in a single pass using either a continuous or pulsed operation. This method of in-situ resource utilization has been studied at a system level, and results published at a national space conference. Phase I of the proposed work will extend the favorable results obtained so far towards a system-level model of the process suitable for more accurate computation of performance metrics. Mathematical models of the SiO₂ molecule dissociation, ionization, transport and separation will be derived and applied to the patented apparatuses. Preliminary calculations on silicon extraction indicate the potential for solar cell production at approximately \$6/Watt, a 50 times improvement over other proposed methods of space-based manufacture. We will apply this novel method of beneficiation to a simultaneous extraction of oxygen and silicon. Key questions to be answered include estimates of the physical dimensions conducive to efficient extraction (Watts/kg, kg/sec), which will drive system parameters of mirror size, solar power needs (for magnetrons and chillers), shielding, thermal management and infrastructure. Milestones within the six-month project will be: (1) vaporization, energy flow and system architecture; (2) addition of self-shielding, double-ionization, three-dimensional considerations and slag rates; (3) inlet design considerations, multiple molecule separation, and velocity profiling; and (4) composite separation rates and overall transfer function characterization. Upon completion of Phase I we will have detailed design equations needed to construct a prototype oxygen extraction unit during Phase II.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

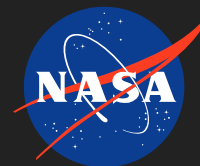
Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer



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Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center (MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Packer Engineering	Supporting Organization	Industry	Naperville, Illinois

Primary U.S. Work Locations

Alabama	Illinois
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Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - └ TX07.1 In-Situ Resource Utilization
 - └ TX07.1.3 Resource Processing for Production of Mission Consumables